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THE
AMERICAN
MATHEMATICAL MONTHLY.

Entered at the Post-office at Springfield, Missouri, as second-class matter.

VOL. XVIII. AUGUST-SEPTEMBER, 1911. NOS. 8-9.

THE TEACHING OF MATHEMATICS IN SUMMER SESSIONS OF UNIVERSITIES AND NORMAL SCHOOLS.*

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THE SUMMER SESSIONS IN GENERAL.

Previous to the year 1891 there had been no general movement in this country to organize summer courses in connection with the schools, colleges, and universities. Certain summer courses for teachers had been offered at Harvard University as early as 1871, but not until 1891 were any regular courses in mathematics given. In 1891 also certain courses in mathematics and latin were offered in a summer session at the State Normal School at Emporia, Kansas, as a private undertaking of two instructors in the school. In like manner some summer courses were offered in the same year at the University of California, the University of Indiana, and the University of Minnesota. No doubt, complete data would show that similar beginnings were made about this time, or not much later at other institutions. Cornell University made a start in 1892, the University of Missouri and the University of Illinois in 1894, and the University of Texas in 1897. In most of these cases, if not all, the beginnings were made by a few instructors who carried on the work as a semi-private undertaking, depending wholly upon the tuition receipts for their remuneration.

The University of Chicago was the first institution to embody in its constitution a provision for a regular summer session conducted by the permanent faculty under conditions precisely similar to those in the other sessions of the school year. President Harper maintained that to allow a great and costly University plant to stand idle during one quarter of the year was neither good business nor good educational policy. He held that the advantages of college and university training should not be kept forever out of reach of those who were engaged in teaching and who could not afford to give up their positions in order to attend the university during the nine months from October to June. How keen was his prophetic vision and how great a boon he conferred upon the teachers of the country may be inferred from the data of attendance shown in the tables of statistics given below. No summer session was held at Chicago during the first year, 1892-3, on account of the Columbian Exposition in close proximity to the campus, but the summer quarter of 1894 was attended by 597 students, and the enrollment for the next seven summers was as follows: 931, 1048, 1273, 1434, 1636, 2375.

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* This paper was prepared on short notice at the request of the American Commissioners of the International Commission on the Teaching of Mathematics. They discovered at the last moment that this phase of work for the preparation of teachers had been overlooked in the assignment of jurisdiction to other committees. As there was not time for an exhaustive investigation, it was decided to gather data from a limited number of representative institutions and to draw such conclusions as might be possible on this basis.

The steadily growing attendance at these summer sessions, the serious character of the work done, the extent and variety of the courses offered both for elementary and advanced students, the devotion to this cause of the regular university faculty on exactly the same terms as at any other session of the year,—these were new phenomena in the educational development in this country which may well be characterized as the beginning of an epoch; namely, the adoption of the summer session as a part of the regular program in many colleges and universities.

It cannot, however, be said that this program has been, or is likely to be universally adopted by the colleges and universities. Indeed, in the nature of the case, only the larger institutions, and especially the State universities, are likely to develop this phase of work strongly. Inasmuch as the constituency of the summer session is very largely from the ranks of teachers, it is natural that those institutions which have developed strong departments, or schools of education, should attract the larger number. One by one these institutions have organized the work of the summer session; usually at first in a tentative way, being in charge of a few instructors who might assume the responsibility and derive such revenue as the tuition fees would afford; later receiving official endorsement both as to financial responsibility and in the granting of credit toward degrees for work done in these courses. In many cases it is only recently that full credit for summer work has been accorded toward the Bachelor's degree, and in very few instances even yet can credit toward a higher degree be obtained, as at Chicago and Wisconsin. Columbia for example, explicitly provides that credit for work in the summer sessions may count toward the Bachelor's or Master's degree but not toward the Doctor's degree. The extension of the credit privilege corresponds closely to the gradual development of the summer programmes. Naturally the beginnings were made in most cases with elementary courses only, and later advanced courses were gradually added. Chicago furnishes a notable exception to this manner of development. There the full curriculum of courses, elementary and advanced, could be found from the very outset and all degrees were included in the range for which credit could be received.

The following table shows certain general data concerning the summer sessions of eighteen universities which are sufficiently representative to indicate the extent to which this phase of work has gained recognition.

TABLE I.

Institutions.	Date of Organizing Summer Courses.	Number of Weeks in the Summer Sessions.	Attendance for past five years:				
			1906.	1907.	1908.	1909.	1910.
California	1891	6	706	522	661	819	1051
Chicago	1894	12	2688	2605	3050	3264	3370
Columbia	1900	6	1043	1392	1998	1946	2629
Cornell	1892	6	642	755	841	889	987
Harvard	1871	6	779	809	1116	903	873
Illinois	1894	9	423	502	555	631	665
Indiana	1890	12	682	721	1005	1139	1107
Iowa	1900	6	281	344	363	363	347
Kansas	1903	6	264	289	377	374	390
Michigan	1894	8	1034	1070	1085	1224	1234
Minnesota	1891	6	1019	1035	1218	1286	1188
Missouri	1894	8	403	542	508	552	576
Oberlin	1899	8	142	136	142	160	154
Ohio State	1905		385	425	508	642	639
Pennsylvania	1904	6	505	707	879	826	1219
Texas	1899	7	444	580	625	741	848
Washington State	1904	6	198	243	235	288	303
Wisconsin	1899	6	650	750	1025	1125	1253

Remarks on Table 1. At the University of California, summer courses have been given since 1891, but the first regular summer session was held in 1900, since which time full credit toward the baccalaureate degree has been allowed for all summer courses of college grade. This is typical of many other institutions, for instance, at the University of Illinois, summer courses were given since 1894, but the regular sessions granting credit for work of a college grade began in 1900.

The figures for the University of Minnesota and for the University of Texas include those registered for elementary work as well as those taking work of college grade. At the University of Texas the summer session is combined with a summer normal school. This arrangement prevails also in some other cases, for instance, at Tulane University, where the summer session was introduced in 1910.

MATHEMATICS COURSES IN THE SUMMER SESSIONS.

The foregoing general statement with reference to the development of the summer sessions in American universities forms an appropriate background for the consideration of the work of mathematics in particular in these sessions. It appears that the courses in mathematics have been regarded in most cases as of special importance in these summer curricula. In fact, in several instances the work began with courses in mathematics and perhaps no other subjects, and was gradually extended to include courses in all the regular departments as the number of students increased and the demand became apparent.

The courses offered in mathematics may be roughly divided into two classes: (1) those intended primarily to emphasize the pedagogical aspect of the subject, and (2) those intended primarily to develop the subject matter for its own sake or as a prerequisite to other courses. The pedagogical courses include critical studies of the various elementary and secondary branches with reference to scientific interpretation and methods of presentation, and also studies in the history of mathematics with special reference to the needs of teachers in elementary and secondary schools. As yet there appear to have been no pedagogical courses offered for the special benefit of teachers of college mathematics, but it may be said that practically every course offered in the summer session becomes in a certain sense a pedagogical course, since so large a proportion of the students are teachers who are keenly alive to their opportunities for observation. In fact it is a common occurrence in these summer courses for students to register for the purpose of studying the teacher quite as much as for studying the subject. Moreover, it is believed by many that the best pedagogical training comes through careful and diligent study of the subject matter, under the guidance of an inspiring teacher who knows how to exhibit good methods and to impress them upon the students by example, rather than by precept. However, there is undoubtedly a growing tendency to attach greater importance to definite, scientific study of the art of teaching, and this tendency is shown in the increasing number of pedagogical courses offered in colleges and universities, especially in the summer sessions, and in this respect mathematics is well represented. Naturally such courses appear most strongly in those institutions in which the department of education, or the separate school of education, is most fully developed.

Of the courses intended primarily for the study of subject matter, comparatively few extending beyond elementary calculus are offered in summer sessions, except in one or two institutions, notably at Chicago and Wisconsin. This may be accounted for in two ways: (1) because in most cases the great majority of students in the summer sessions are not prepared for advanced work, and (2) because the summer school usually has no endowment and the receipts from tuition fees are not sufficient to provide the more expensive iustruction in advanced courses where the enrollment is comparparatively small. The following statement from the former director of the Harvard summer school is fairly typical of the way in which the mathematical work has developed in the summer sessions in other institutions: "Mathematical courses were first introduced into the Harvard summer school in 1891. Courses in solid geometry, plane trigonometry, and college algebra have been given regularly for the past twenty years. Courses in analytic geometry have been given regularly for the past ten years. Courses in calculus regularly for the past seven years. In 1903 a course was given in the theory of functions, and in 1909 a course in modern methods in geometry. In 1910 the following advanced courses were offered: Introduction to modern geometry, topics in the theory of functions, each with very small registration."

The following table shows certain data with respect to mathematics in summer sessions.

TABLE II.

Institutions.	Registration in Mathematics Courses 1906	1907	1908	1909	1910	Elementary Courses including Calculus	Advanced Courses beyond Calculus	Pedagogical Courses
California	41	38	63	60	108	4	1	1
Chicago	286	316	350	380	493	12	4	3
Columbia	130	160	170	210	275	7	3	2
Cornell	Not reported			369	375	8	2	2
Harvard	58	54	43	37	40	5	2	1
Illinois	110	136	152	183	164	5	4	1
Indiana	98	150	177	173	189	4	2	—
Iowa	46	80	73	68	61	7	—	2
Kansas	13	21	13	20	39	3	1	—
Michigan	Average of 155 per year					6	4	1
Minnesota	Average of 100 per year					3	—	—
Missouri	95	98	56	79	85	5	1 or 2	1 or 2
Nebraska	33	33	30	32	42	4	—	—
Oberlin	Average of 35 per year					4	—	1
Ohio State	Not reported				113	4	1	1
Pennsylvania	88	129	151	121	184	11	—	1
Texas	348	420	454	446	342	3	—	1
Washington State	27	29	19	22	22	1	—	2
Wisconsin	142	117	249	225	242	9	4	—

Remarks on Table II. The data at hand do not make it clear in all cases whether the figures in the above table indicate the total registration or the actual number of different students, as in the case of Iowa and Kansas and Oberlin. The numbers for Texas include attendance upon mathematics courses in a summer normal school which is held in connection with the summer school of the university.

At the University of Pennsylvania no advanced course in mathematics was offered in the summer of 1910, though three or four courses had been offered up to that time. Also the elementary courses include some preparatory subjects which will not be given hereafter. (The data as to courses in all cases refer to 1910 unless otherwise specified.)

At the University of Iowa, while no advanced courses are scheduled, yet those students in the summer sessions who desire some advanced work are cared for in small groups as far as possible.

At the University of Kansas no advanced courses have hitherto been offered. Two are to be given in 1911.

The registration in mathematics at Indiana University and at the University of Chicago is given for the first six weeks of the summer sessions. The attendance is considerably diminished during the second six weeks. These are the only institutions reported in which the session consists of two terms of six weeks each.

At the University of Illinois, previous to 1910, courses in preparatory subjects were offered. The registration given in the table is exclusive of these courses.

THE TRAINING OF TEACHERS.

In general it may be said that a large number of those in attendance at the summer sessions are teachers spending a part or all of their vacation in study, but it does not follow that all are seeking the strictly pedagogical courses. In fact, very many are pursuing courses for degrees and are therefore filling out requirements or choosing elective work in subject matter in which they are interested. It is true, however, that in most cases where special courses of a pedagogical character are given they are well attended and fully appreciated. On the other hand, there is a wide difference of policy, among the institutions offering summer work, as to the usefulness of the pedagogical courses as compared with the content courses.

The following comments from reports of various institutions in the above list will illustrate these points with respect to the department of mathematics.

"As seen from our enrollment the interest in summer school mathematics is not very great, most teachers preferring work which does not demand so great a strain as the study of mathematics. Whatever work is done has a decidedly beneficial influence upon those who take it."

"Only one course in the pedagogy of mathematics has been offered and this has not been largely attended. It is not possible to form any estimate as to the influence of this work in general upon the preparation of teachers of mathematics."

"A course in algebra has been given from the first, arranged with special reference to broadening the point of view of the high school teacher. Graphical methods are developed, the theory of complex numbers presented and the notation of determinants explained. For the last four summers a course in the history of mathematics has been offered, in which the development of geometry and algebra is traced as carefully as may be from the earliest times. A large proportion of the students in mathematics are enrolled in one or the other of these two courses for teachers and their obvious interest in, and profit from, the work has been gratifying. It is believed that the direct influence of these summer courses upon the school teachers, by far the most numerous class of students in the session, is greater than that of any other work which we do during the academic year."

"Of the advanced courses given in 1910, two were special courses intended for the training of teachers in mathematics. In the one year of their existence these two special courses for teachers attracted many students who showed much interest in the work. It is the estimate of the department of mathematics here that the summer sessions have had good influence upon the preparation of teachers of mathematics."

"In general, the demand for the advanced courses in the summer sessions tends to increase while that for the most elementary courses is stationary or decreasing. Many courses, especially those of intermediate character on such subjects as modern geometry, projective geometry, and selected topics in algebra, are especially adapted to teachers. Some of these courses are very stimulating to them and show them how to use the literature and text books in their subjects more adequately. Not a few of the teachers in attendance in mathematics in the summer sessions drift later into the university."

"The special courses intended for the training of teachers in mathematics have been (1) a general course covering the usual high school work, and (2) conferences. It should be added, however, that great emphasis is laid on those aspects of all the courses which are specially helpful to teachers. The interest in these courses manifested by teachers and persons preparing to teach has been distinctly good. We think the summer work has had a decidedly beneficial influence on the preparation of teachers in mathematics. It seems repeatedly to have led teachers to enter the University for the purpose of completing their college courses. We have frequently heard encouraging remarks from teachers concerning the benefit they have derived from their summer work. Every thing considered, the summer session seems to have had even a greater influence on the efficiency of teaching than the regular sessions."

"No special courses in mathematics for the training of teachers are offered during the Summer, this work being given during the regular year."

"No course in mathematics is presented for the special purpose of teaching the students how to teach the subject, but frequent suggestions are given to that end. Most teachers who take them do so for the subject matter, as well as to observe how those in charge of the courses present them."

"All those in the course for teachers take a great interest in the subject and do much collateral reading in our extensive pedagogical library in mathematics. All express themselves as greatly benefitted by the course. Many in the course have had from three to ten years' experience in teaching."

"During the past ten years a course in the history and teaching of elementary mathematics has been given about five different times. Interest in these several courses intended for the training of teachers of mathematics, on the part of college students, has been very slight, registration in them being composed mainly of teachers in service. The influence of the summer courses upon the preparation of teachers of mathematics has been very helpful to the rather limited number of teachers who have attended the courses."

"The courses in mathematics, especially the one for the training of teachers, have called forth a good deal of interest and have been very valuable and inspiring. Even more satisfactory is the teachers' course which we carry throughout the college year, enrolling both those who have taught mathematics and those who are looking toward teaching in secondary schools. We are convinced that the teaching efficiency of these students is greatly increased by reason of their facing in this way the various problems that they will meet at the outset of their teaching experience."

It may be noted that the establishment of well organized schools of education, on the same basis as other professional schools, in some of the leading universities has had a marked influence upon the standards which the public schools are beginning to prescribe with respect to the preparation of their teachers, and wherever these professional schools for teachers hold summer sessions the attendance is large and increasing and the interest is rapidly growing. Some states are already prescribing by statute a minimum of work in education which must be fulfilled by all candidates for high school positions. One of the leading states in this respect is California, where a year of post-graduate work in education in the state university, or in a university of equally high standing, is demanded of all high school teachers. The work in the summer session is allowed to count toward fulfilling this requirement. This will explain the following extract from the California report. "The majority of the students in the summer sessions are from the high schools of the State, with an increasing number of graduates of other institutions who are preparing to teach in our high schools. We require a year of graduate work for the high school certificate, and have recently agreed to accept summer session residence at the rate of four summer sessions for one year of the regular session. We find considerable interest among our best high school teachers in the summer session courses, and believe we are able to help them to a broader view of the subjects which they have to teach. The demand which they make on us for these courses is increasing every year, and is larger than we are able to meet for advanced work, owing to the fact that the administration still insists that the summer session must pay for itself."

Another feature of growing significance is the fact that the number of men, in proportion to the women, is steadily increasing in the professional schools of education, as is not the case in the ordinary normal school. This is particularly noticeable in the summer sessions of the larger universities where the professional side of education is most largely developed. This seems to indicate that the demand for teachers, and particularly for men, with professional training is increasing, and teachers everywhere are beginning to recognize the necessity of such training in order to secure advancement in rank and salary. The first step is naturally the summer school and this explains the rapidly increasing attendance upon these sessions all over the country, and by all classes of teachers from the elementary schools to the high schools and colleges.

SUMMER SESSIONS IN NORMAL SCHOOLS.

Reports have been received from a limited number of representative normal schools in various parts of the country. In a general way it may be said that the normal schools in the East and in the far West do not hold summer sessions, and that those in the middle West do hold summer sessions, often extending through twelve weeks. There are important exceptions to this statement, and of course, there are many institutes and various kinds of summer schools for teachers which provide lectures and other forms of instruction through periods of from one to four weeks, but which are not here classed with those summer sessions which provide continuations of the regular work in normal schools.

Extracts from a few replies: "The two normal schools in New Jersey hold no summer session since their services are not needed in view of the large opportunities offered in the universities of New York."

"The only normal school in Massachusetts which makes much of summer work is that at Hyannis."

"The normal school at Danville, Conn., has held a four weeks session during July, beginning in 1908. Its object is to give to teachers of common schools who consider themselves unable to take the regular two years' course a brief summary of the common school subjects, what to teach and how to teach it."

"We have in Maryland two normal schools, neither of which holds a summer session."

"The State normal school at Los Angeles, California, has never held summer sessions. Generally one of the five normal schools in the state holds a summer session, but none will be held this year (1911)."

"The two state normal schools of Ohio, one at Oxford and one at Athens, hold summer sessions. The former began the Summer work in 1903 and has had an attendance in each of the last five years ranging from 550 to 700. The registration in mathematics classes has averaged about 170. For the session of 1911 nine courses in mathematics are offered, from arithmetic to trigonometry, and including two courses on the teaching of elementary mathematics."

"The state normal school at Kirksville, Missouri, has held four sessions of twelve weeks during each of the past eight years. The attendance during the summer term has varied during the past five years from 500 to 610. The estimated registration in mathematics courses each year has been about sixty per cent of the total attendance. Courses of both high school and college rank are offered from elementary algebra to calculus, including two courses in the teaching of mathematics. The influence of our mathematics courses has been to induce many students to return to the institution summer after summer for mathematics and other subjects. Many of our mathematics students discover, while here, their ability in mathematics, and develop a desire to be specialists in the subject."

"All of the Michigan state normal schools hold summer sessions. The one at Kalamazoo began on this plan at its organization in 1904. The attendance during the past seven years has increased from 117 in 1904 to 834 in 1910. The courses offered in mathematics below calculus are college algebra, trigonometry, elementary algebra, and geometry. A teachers' course in arithmetic and review arithmetic are intended for the training of teachers of mathematics. Regarding the influence of this work upon the preparation of teachers of mathematics, I will say that very great interest has been shown, especially on the part of those preparing for the grades; also many have taken work looking forward to teaching high school mathematics, and a number of graduates have continued work in the universities."

"All of the Wisconsin state normal schools hold summer sessions. The one at Platteville began two years ago with a session of six week's duration, and last year (1910) had an attendance of 265, of whom about 160 were registered in elementary mathematics courses. We have little opportunity as yet to judge as to the effect of these courses upon the preparation of teachers of mathematics."

All of the normal schools of Illinois hold summer sessions and at least one, at Normal, Illinois, has a session of twelve weeks. All these sessions are largely attended.

"The state normal school at Emporia, Kansas, has had summer sessions in some form since 1891. Mathematics and latin were the only subjects in which instruction was given at that time. The summer session soon developed into a regular feature of the institution and for a number of years past has been organized upon exactly the same basis with respect to employment of faculty, records, and requirements, as at any other portion of our school year. It constitutes one of the five terms of the year. In other words, we do in the summer school the work of one-half a semester,— nine full weeks of class work. The courses offered in mathematics have been the regular work of the normal school in arithmetic, algebra, and geometry of secondary grade; and in higher algebra, trigonometry, surveying, analytics, and calculus of college grade. The other normal schools of the state, one of them eight years old, the other ten, have had summer sessions on the same basis ever since they were organized. The attendance at Emporia, in 1910 was 1200, and the number of people enrolled in mathematics courses was 305. During the past five years the average attendance has been about 1000, the registration in mathematics approximately 250. We draw from all classes of teachers in the state including many who are doing high school work, and the general influence upon the teaching work of the state has been quite extensive. It is difficult to give any accurate or specific data with regard to this, but in all of the courses offered in mathematics it has been the intention to consider them as specially organized with reference to preparation for teaching."

Enough has been said to indicate the general influence of the normal school summer sessions, especially in the middle West. It is clear that for teachers, especially in the common schools and in the elementary schools, these sessions afford opportunities otherwise out of their reach and insure to large numbers of teachers a growth in effectiveness and an enlarging interest in their work which they could obtain in no other way. Of these general advantages, the teachers of mathematics probably enjoy a larger share than any others, since the data seem to indicate that a relatively larger number of teachers are registered for mathematics courses than is the case in other departments.

Finally, one other phase of summer school work should be mentioned, namely, that which has been held at Chatauqua, New York, since 1878. While this began, and was long continued, largely in the form of popular lectures, in more recent years organized class work has been carried on in many departments of the school and college curriculum, including mathematics. The attendance is large and the interest is great. Much attention is given to arithmetic, algebra, and geometry, and no doubt the influence upon the teaching of these subjects is wide-spread and important.

CONCLUSION.

It has been seen that the summer session is a development of the last twenty years, and more extensively of the last ten years. Many colleges and most of the universities are now holding summer sessions. Particular interest centers in those institutions where schools of education have been established on a professional scale or where the department of education is recognized as of leading importance. But even in those institutions where this is not the case, much of the work of the summer session has a pedagogical character due in part to the method of presentation and in part to the critical observation of the instructor by the summer students who are themselves teachers. The normal schools, especially of the middle West, are using the summer sessions to the very great advantage of large numbers of teachers who, otherwise, would be deprived of the opportunity for advancement and growth in the profession of teaching. The department of mathematics has its full share of patronage in the summer sessions and is doing its full quota of work in this form of preparation for teaching.